

THE UNIVERSAL SW-3 RECEIVER



National Company, Inc.
Malden, Mass.
U. S. A.

THE UNIVERSAL SW-3 RECEIVER

Description

General

THE Universal Model SW-3 Receiver employs a three-tube "regenerative-detector" circuit; one tube is used as an R.F. amplifier, a second as a controlled-regenerative detector and a third as an audio amplifier. Plug-in type radio frequency transformer coils in combination with a two-section variable capacitor are employed to tune the frequency range of the receiver. A separate power unit is used when the receiver is operated from AC lines. External batteries are employed for DC operation.

The receiver is compact, efficient and simple in its operation, making it ideal for portable or

emergency service and for the radio amateur. It can also be used as a very effective pre-selector for a short-wave receiver by simply coupling the antenna circuit of the receiver to the detector stage of the SW-3. A two or three turn link coil wound over the detector transformer coil and connected to the receiver input terminals with a short twisted line will be found satisfactory.

While headphone output only is provided, a separate audio amplifier and power supply may be used if loudspeaker operation is desired. The amplifier should preferably be of the push-pull type and be transformer-coupled to the output of the SW-3. Dwg. No. 4 shows a recommended circuit, less power supply.

Installation

Antenna Recommendations

ANTENNA input terminals are located at the rear left side of the receiver chassis. The input circuit is suitable for use with a single-wire antenna, a balanced feed line or a low impedance concentric transmission line. A short flexible grounding lead is attached to the chassis.

When using a single-wire antenna, the lead-in should be connected to the input terminal nearest the front of the receiver and the flexible lead, mentioned above, should be attached to the other terminal. The dimensions of the single-wire antenna system are not critical, the recommended length, including lead-in, being 75 to 100 feet.

Feed lines of doublet systems should be connected to the two input terminals; the flexible lead is not used.

The inner conductor of a concentric transmission line should be connected to the input terminal nearer the front of the receiver. The outer conductor and the flexible grounding lead should be connected to the other terminal.

An external ground to the chassis may or may not be necessary. It should be used unless it reduces signal strength.

Power Requirements

The Universal Model SW-3 can be operated from either an AC source in conjunction with a

National Type 5886-A11 Power Unit or from a combination of batteries. When AC or battery operated using one 6C5G and two 6J7G tubes, the heater circuits require .9 amperes at 6.3 volts; a "B" supply of 135 volts is recommended. When battery operated using one 1A5G and two 1N5G tubes, the filament circuits require .15 amperes at 1.5 volts; a 90-volt "B" supply is recommended.

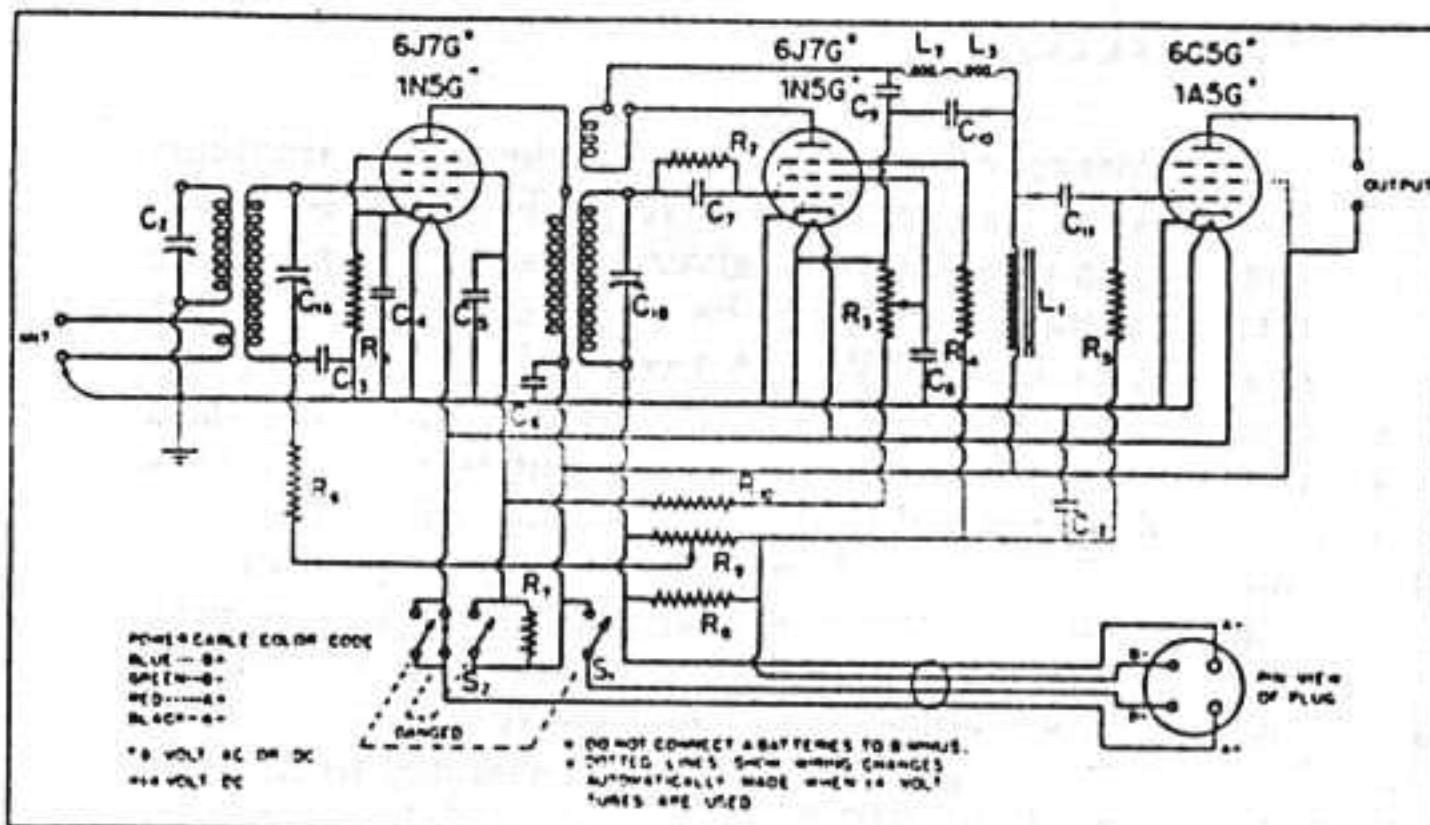
When using the 6.3-volt type tubes, the change-over switch mounted at the rear left-hand top of the chassis must be set in the "6.3" position. When the 1.4-volt series of tubes is used, the change-over switch must be set at "1.5."

A four-wire cable and plug is attached to the SW-3 Receiver. Plug prong connections are as shown in Dwg. No. 1. When AC-operated, the plug should be inserted in the output socket of the National Type 5886-A11 Power Unit. When battery-operated, battery leads may be wired to a four-prong socket and the receiver cable and plug used to complete inter-connections. Alternatively, the plug may be removed and the cable leads connected directly to the battery terminals.

The National Type 686 Vibrator Pack is recommended for use with the SW-3 when a 6-volt DC source is available and when additional batteries for the "B" supply are not desirable. The plug connections of the SW-3 power cable are wired to match the output socket of the 686 Pack.

A type 6X5 tube *must* be used as a rectifier in the 6S6 Pack, although the rectifier socket is wired so that an OZ4 tube may be substituted without circuit changes.

Two types of commercial vibrator packs are generally available; the self-rectifier and the tube-rectifier. Of these, the latter is recommended, but only when a heater type of tube such as the 6X5 is employed. Packs having a cold-cathode gas rectifier tube such as an OZ4 cannot be used since the "B" current drain of an SW-3 is below the minimum value at which the tube functions normally.



DWG. NO. 1—CIRCUIT DIAGRAM OF THE UNIVERSAL SW-3

C₁—dual variable air capacitor, 90 mmf. per section.
C₂—Variable air capacitor, 50 mmf.
C₃—.01-mfd., 400-volt paper capacitor.
C₄—.1-mfd., 400-volt paper capacitor.
C₅—.1-mfd., 400-volt paper capacitor.
C₆—.1-mfd., 400-volt paper capacitor.
C₇—.0001-mfd., mica capacitor.
C₈—1-mfd., 200-volt paper capacitor.
C₉—.00025-mfd. mica capacitor.
C₁₀—.00025-mfd. mica capacitor.
C₁₁—.01-mfd. mica capacitor—part of coupler.

C₁₂—25-mfd., 50-volt elec. capacitor.
L₁—700-henry choke—part of coupler.
L₂—2.5-m.h. R.F. choke.
L₃—5.5-m.h. R.F. choke.
R₁—500-ohm, 1/2-watt resistor.
R₂—5-megohm, 1/2-watt resistor.
R₃—50,000-ohm potentiometer.
R₄—5,000-ohm, 1/2-watt potentiometer.
R₅—.25-megohm, 1/2-watt resistor—part of coupler.
R₆—50,000-ohm, 1/2-watt resistor.
R₇—70,000-ohm, 1/2-watt resistor.
R₈—2,000-ohm, 1/2-watt resistor.
R₉—3,000-ohm potentiometer.
R₁₀—20,000-ohm, 1/2-watt resistor.
S₁—DPDT toggle switch.
S₂—DPDT toggle switch.

In no case should a common connection be made between B- and heater circuits. Such a connection would remove the bias voltage from the audio tube. For this reason, the heater center-tap resistor of all new Type 5886-AB Power Supplies is omitted. This omission will not affect the operation of any other National equipment for which

the 5886-AB is recommended. The heater center-tap resistor must be removed from an older 5886-AB Supply when used in conjunction with a Universal Model SW-3.

R.F. Transformer Coils

Thirteen sets of plug-in coils are used to tune from 9 to 3000 meters. Five additional sets are used to bandspread the 10-, 20-, 40-, 80- and 160-meter amateur bands. See Dwg. Nos. 2 and 3 and the coil listing on page 12.

When operation on any general coverage range is desired, the proper set of coils should be plugged into the receiver coil sockets. R.F. amplifier and detector coils of Sets No. 30 to No. 35 and No. 39 to No. 41, inclusive, are identical and may be interchanged in the coil sockets of the receiver. Coils of Sets No. 36, No. 37, No. 38 and No. 42 are not interchangeable. The coil forms of these sets are marked on the bottom outside near the prongs—"D," detector coils; "R," R.F. amplifier coils.

With a band-spread range in use, the receiver will not function properly if the R.F. amplifier and detector coils are interchanged in the receiver coil sockets. The detector coil can be readily identified by the variable trimmer capacitor mounted at the top of the coil form. When the band-spread coils are used, the grid leads attached to the receiver should be removed from the tube grid caps and clipped in place on the insulated posts mounted

on the sides of the metal shields next to the main tuning capacitor. The grid leads of the coils should be attached to the proper tube grid caps.

In all models of SW-3 Receivers, the R.F. amplifier coil socket is located at the left of the main tuning capacitor, as the receiver is viewed from the front; the detector coil socket is at the right side.

Operation

Controls

THE main tuning dial of the SW-3 Receiver is mounted on the front of the cabinet at the center. It is of the variable ratio type. A control lever is provided to adjust the control knob-to-

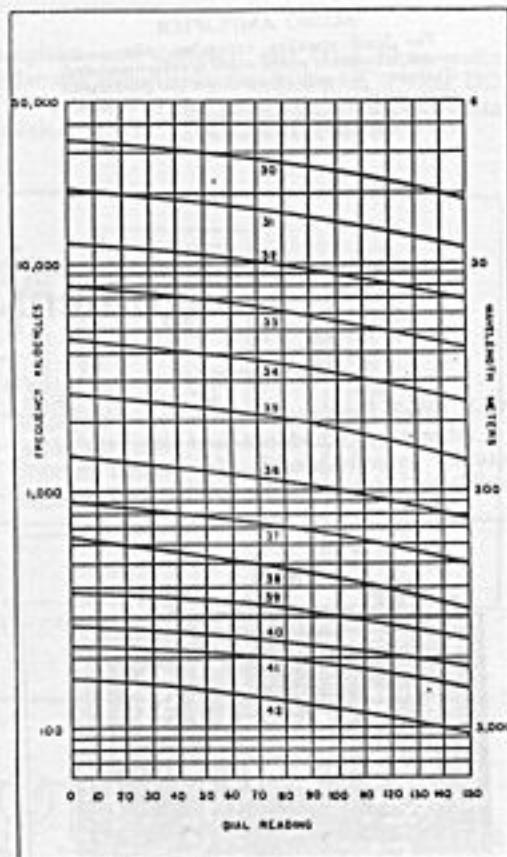
capacitor drive coupling ratio to any desired point between the limits of 6 to 1 and 18 to 1. Scale graduations are from 0 to 150 divisions over the 270 degrees of rotation through which the dial turns the main capacitor. Calibration curves (Dwg. Nos. 2 and 3) show the approximate fre-

quency to which the receiver is tuned.

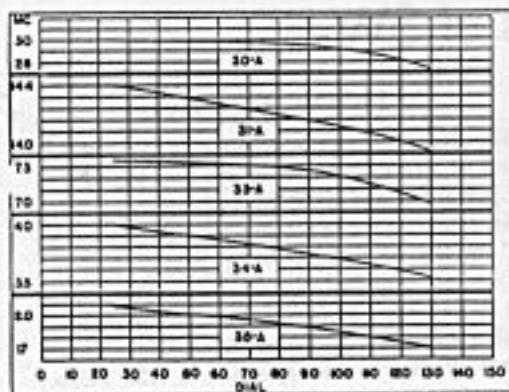
To the left of the main dial is the R.F. amplifier trimmer capacitor. This control is used to compensate for minor mistacking of the R.F. amplifier stage, as may be caused by antenna detuning. The trimmer knob should be adjusted to give maximum sensitivity, in the following manner: The regeneration control should be advanced beyond the point of detector oscillation. As the R.F. amplifier trimmer capacitor is rotated back and forth or "rocked," the regeneration control should be slowly retarded. At one adjustment of the latter, the detector will oscillate only with the R.F. amplifier trimmer set at a definite point. It is at this point that the R.F. amplifier and detector circuits track, and the receiver has maximum sensitivity.

Below the main dial is the R.F. gain control. The control disc is arbitrarily calibrated from 1 to 9. The purpose of the gain control is to adjust the amplification of the R.F. amplifier tube. Amplification increases as the control is turned toward 1. The graduated R.F. gain control makes possible reasonably accurate measurement of signal input, as follows: With the receiver tuned to either a modulated or unmodulated carrier, the R.F. gain control should be retarded until the signal is barely audible. The gain control disc number centered in the panel opening below the main dial will indicate the signal input in S units, a term commonly used by radio operators.

The regeneration control is located to the right of the main dial. It is used to adjust the voltage applied to the screen of the detector tube. As the control knob is turned in a clockwise direction, the amplification of the detector tube increases up to the point at which oscillation takes place. When receiving modulated signals (phone), best sensitivity will be had with the detector operated just below the point of oscillation. For C.W. (code) reception, the detector must be oscillating to produce a beat note, the frequency of which will be determined by the main dial setting.



DWG. NO. 3 - GENERAL COVERAGE COIL CALIBRATION CURVES



DWG. NO. 2 - BANDSPREAD COIL CALIBRATION CURVES

At the left side center of the cabinet front panel is mounted a toggle switch. When the change-over switch mentioned under "Power Requirements" is set at "6.3," the panel toggle switch is used to open the receiver "B" circuits and silence the receiver as may be necessary during periods of transmission. With the change-over switch referred to above set at "1.5," the panel toggle switch is used as a battery ON-OFF control, opening both the filament and "B" circuits. It is also used to silence the receiver during transmission periods. With this system, power consumption is reduced to a minimum during "stand-by" periods.

A headphone output jack is located at the center right section of the cabinet front panel. The headphones used should be of the magnetic type having an impedance of approximately 20,000 ohms, as is usually the case when the DC resistance is from 2000 to 3000 ohms. The headphone jack is connected in series between the plate of the output tube and B+. Crystal headphones and some special types should not, therefore, be used with the SW-3 unless a coupling transformer is employed.

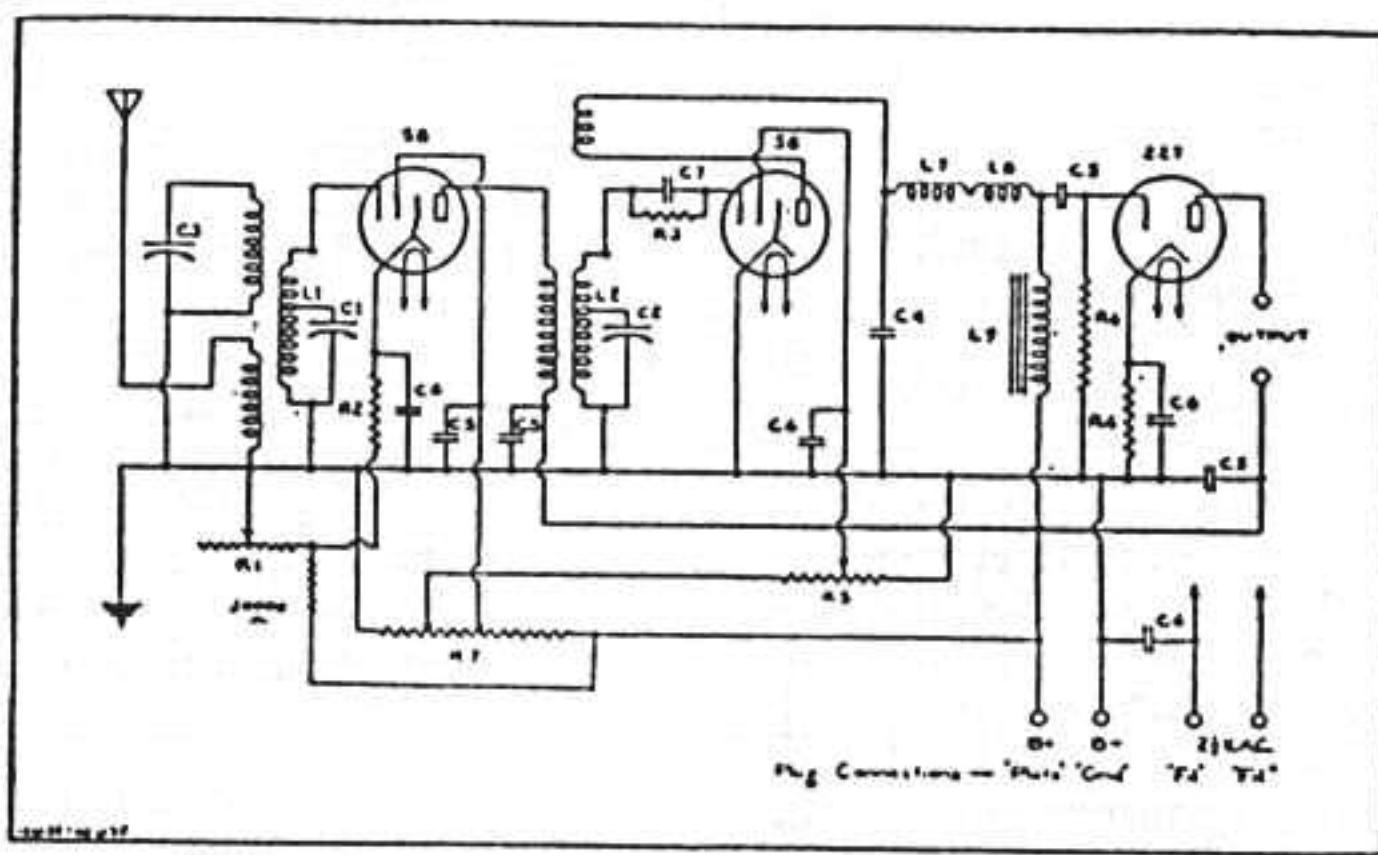
2V DCSW-3 Receiver

Dwg. No. 7 shows the circuit diagram and parts list. Two-type 32 tubes are used as R.F.

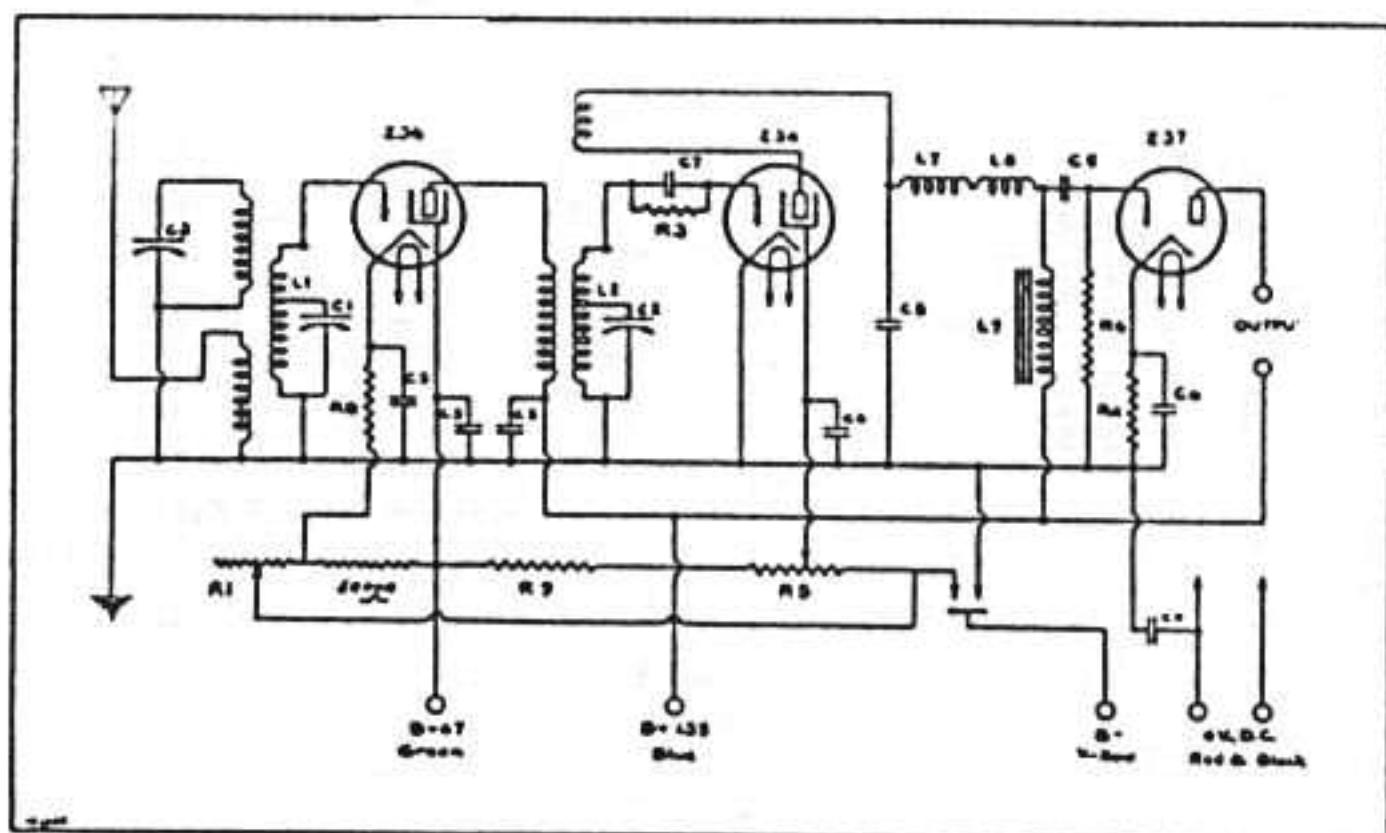
amplifier and detector, one type 30 as audio. Filament circuits require .16 amps., 2 volts DC; "B" circuits, 67 and 135 volts; and bias circuits, 3 volts. "10-12" series coils are used.

ACSW-3 PARTS LIST

C₁ — Dual variable air capacitor, 90 mmf. per section.
 C₂ — Part of C₁, ganged.
 C₃ — Variable air capacitor, 50 mmf.
 C₄ — .00025-mfd. mica capacitor.
 C₅ — .01-mfd. mica capacitor.
 C₆ — .5-mfd., 200-volt paper capacitor.
 C₇ — .0001-mfd. mica capacitor.
 L₁ — R.F. amplifier transformer.
 L₂ — Detector transformer.
 L₇ — 2.5-m.h. R.F. choke.
 L₈ — 5.5-m.h. R.F. choke.
 L₉ — 700-henry choke — part of coupler.
 R₁ — 10,000-ohm rheostat.
 R₂ — 300-ohm, $\frac{1}{2}$ -watt resistor.
 R₃ — 5-megohm, 1-watt resistor.
 R₄ — 2000-ohm, 1-watt resistor.
 R₅ — 50,000-ohm potentiometer.
 R₆ — .25-megohm, $\frac{1}{2}$ -watt resistor — part of coupler.
 R₇ — 12,000-ohm voltage divider resistor — 3100, 2000, 6900-ohm sections.



DWG. NO. 5 — CIRCUIT DIAGRAM OF THE ACSW-3



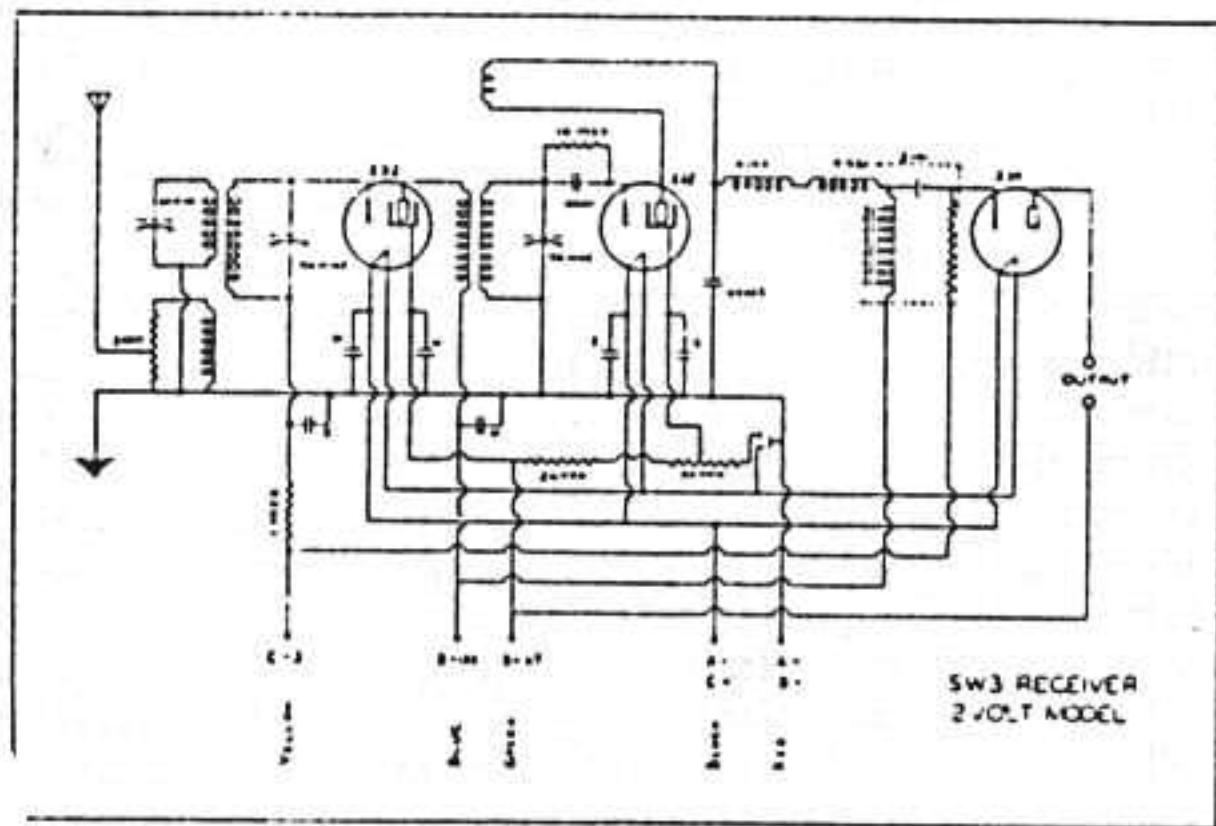
DWG. NO. 6 — CIRCUIT DIAGRAM OF THE 6V DCSW-3

6V DCSW-3 PARTS LIST

The circuit diagram shows types 36 and 37 tubes in place for 6-volt DC operation. By simply substituting type 35 for type 36 and type 27 for type 37, the receiver may be converted to 2.5-volt AC operation, without circuit or coil changes. Circuit constants are identical with those applying to DWG. No. 5 with the following exceptions:

R₈ — 350-ohm, $\frac{1}{2}$ -watt resistor.

R₉ — 20,000-ohm, 2-watt resistor.



DWG. NO. 7 — CIRCUIT DIAGRAM OF THE 2V DCSW-3

Dwg. No. 7 shows the circuit and the values of component parts of the 2V DCSW-3 Receiver. This model was the preferred type for portable operation with low battery power consumption before the introduction of the Universal Model, using 1.4-volt tubes.

UNIVERSAL MODEL SW-3 RECEIVER

PRICE LIST

Universal Model SW-3 Receiver for AC or battery operation; without tubes, coils, headphones or power supply. List \$35.00

General Coverage Coils:

Type No.	Range — Meters	List Per Pair
30	9 to 15	\$3.50
31	13.5 to 25	3.50
32	23 to 41	3.50
33	40 to 70	3.50
34	65 to 115	3.50
35	115 to 200	3.50
36	200 to 360	4.00
37	350 to 550	4.00
38	500 to 850	5.00
39	850 to 1200	6.50
40	1200 to 1500	6.50
41	1500 to 2000	6.50
42	2000 to 3000	8.50

Bandspread Coils:

Type No.	List Per Pair
30A — 10-meter	\$3.50
31A — 20-meter	3.50
33A — 40-meter	3.50
34A — 80-meter	3.50
35A — 160-meter	3.50

Type 5886-AB Power Supply — 115 volt, 60 cycle input — with rectifier tube List \$29.50

Type 686 Vibrator Pack — 6-volt DC input — with rectifier tube List \$45.00

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